Effects of participation in a simulation game on marketing students' numeracy and financial skills

Background and Rationale

Marketing educators strive to provide students with an educational experience that prepares them for successful careers. Their education cannot simply involve the acquisition of a body of knowledge; it must also make them more employable by endowing them with work-relevant skills and competences (Gibson-Sweet et al 2010). In particular, marketing graduates need adequate numeracy skills because marketers are increasingly called upon to be accountable for their decisions. The premise of this study is that marketing simulation games provide an excellent opportunity to improve these skills; consequently, we hypothesize that simulation games are a good medium through which to deliver numerical and financial skills on a marketing degree programme.

Numeracy skills are among the important skills needed by graduates. A study carried out by the Institute of Manpower found that over 85% of jobs required numeracy skills, and 75% needed numeracy skills higher than Foundation Level (Bynner & Parsons, 1997). While there are many definitions of numeracy, perhaps the definition provided by Lockett (1974) is still the most useful. He stated that a numerate employee is one who can make logical deductions, do basic arithmetic, and work with the relevant mathematical symbols, terms and formula used in the profession. These may appear to be quite basic skills and yet many studies have demonstrated that students in higher education today not only exhibit a weakness in basic arithmetic, but show a general fear of numbers and anything related to them. This does not bode well for their ability to succeed in marketing tasks involving setting budgets, interpreting numerical information on the business environment, competitors or customers, or undertaking even basic statistical analysis. Indeed, in line with these studies, our experience has taught us that marketing students, in general, do poorly on these tasks.

Our own previous research has clearly demonstrated the ability of simulation games to engage students in the learning process while also developing a range of key skills and attitudes (reference withheld to preserve review process integrity). This study makes use of a marketing simulation game currently used in our third year marketing strategy module to determine the degree to which participation in such a game improves marketing students' skills in numerical and financial analysis, as well as their perceived self-efficacy in those skills.

Prior research into the educational value of simulation games suggests that they are good at developing key skills and giving participants a "valid representation of real world issues facing managers" (Wolfe and Roberts, 1993, p22) including enhanced skills in strategy formulation, analysis of multiple variables, integration of a range of marketing concepts and tools, manipulating financial concepts, problem-solving, communication and team-work (Keys and Wolfe, 1990; Gopinath and Sawyer, 1999; Jennings, 2001; Zantow, Knowlton and Sharp 2005; Faria, 2001 & 2006; reference withheld to preserve review process integrity). Many studies have demonstrated high correlations between statements such as the game "improved analytical skills", "improved problem solving", "helped learn concepts", and "taught fundamentals".

Very few studies to date have focussed specifically on the ability of simulation games to improve specific and relevant numeracy and financial skills and this project seeks to fill this gap.

Objectives, Method and Instrument Design

The overall goals were to determine the degree to which participation in a marketing simulation game improves marketing students' objective skills in numerical and financial analysis, and how participation affected students' subjective perceptions of their numerical and financial skills.

Hypothesis 1: Marketing students' scores in a standard test of numeracy and financial skills will rise following their participation in a simulation game that requires them to engage in numerical and financial analysis.

Hypothesis 2: Marketing students' self-efficacy in handling numerical and financial issues will improve following their participation in a simulation game that requires them to engage in numerical and financial analysis.

The present project was envisaged as a single-institution exploratory study, with a view to extension to other institutions if the results from this study prove promising. The research design aimed to capture both objective and subjective data about the changes in students' numeracy and financial skills arising from participating in a marketing simulation game for three months. By objective data is meant the results of a test of analytical skills focusing on numerical and financial concepts, while by subjective data is meant the beliefs and perceptions of students concerning their self-efficacy in tackling numerical and financial problems.

The overall research design can be described as a pre- and post-test field experiment. A questionnaire incorporating self-efficacy questions, numeric questions and financial questions was administered at the start of the game, and then again, three months later, at the end of the game. The game (SimBrand, for details see www.cesim.com) is a widely used strategic marketing simulation. It was incorporated into the final year marketing strategy module, with students making weekly decisions as part of the normal teaching and learning process. Weekly seminars were devoted to briefings about how to play SimBrand, the relationship between SimBrand and strategic marketing theory, and tutor guidance on the appropriate methods of analysis and decision-making to deploy in the game. With the aim of achieving high reliability between the two administrations of the questionnaire, exactly the same research instrument was used at the start and at the end of the game. This approach carries a small risk that, at the time of the second administration, some respondents may recollect questions from the first administration. However, the risk here was considered minimal because, firstly, three months elapsed between administrations, secondly, all questionnaires were collected after the first administration, and, thirdly, no feedback was provided to students until after the second questionnaire administration.

Administration of the research instrument was confidential but not anonymous. Since the students were to receive feedback on their performance in the tests incorporated into the questionnaire once the study had been completed, as a form of constructive feedback, it was necessary to record respondents' student identification numbers.

Self-efficacy in numerical and financial tasks had to be captured by the research instrument. It has been emphasised in prior research that the measurement of self-efficacy must be domain specific (Bandura 1977, 1997; Pajares 1996), consequently the decision was made not to use general questions that have been previously developed to measure mathematics self-efficacy, but to develop an original scale for this study. Questions previously used to measure general mathematics self-efficacy concentrate on aspects of pure mathematics (Betz and Hackett 1983), while the questions developed for this study concentrated on quantitative and financial applications in marketing.

The questionnaire comprised four sub-sections. The first asked for basic demographic data: gender, age, ethnicity and prior educational qualifications. The second sub-section focused on student self-efficacy perceptions regarding quantitative and financial analysis for marketing decision-making. Respondents were asked to examine a sales report drawn from a case study in a strategic marketing textbook. Five calculations or tasks were described for this sales report, representing quantitative thinking activities that would commonly be associated with marketing analysis (for example, to calculate the sales generated for every £1 of advertising spent). The respondents were asked to indicate the level of confidence they felt that they would be able to undertake these tasks correctly. An eight-point confidence scale, drawn from Pajares & Graham (1999), was used anchored by "Not confident at all" (1) and "Completely confident" (8). The five questions and eight-point scale gave a self-efficacy score of between 5 and 40 for each respondent. The mean self-efficacy scores (that is, total score divided by five) were used in the analysis, and are reported in Table 1.

The third and fourth sub-sections of the questionnaire comprised 15 quantitative test questions, each with a unique correct answer. Respondents had to answer these questions without the use of a calculator. Eleven of the questions required mental arithmetic. These questions were calibrated to be at the level expected of a typical English school leaver; specifically, the easier questions were designed to match the foundation and higher-tier levels of the British GCSE in mathematics (non-calculator paper), while harder questions slightly exceeded this level. The remaining questions concerned concepts in financial accounting, and were based on a simple profit and loss statement drawn from an introductory marketing textbook. Following the administration of the questionnaire, the researchers marked these questions manually and gave each respondent a score between 0 and 15. The questionnaire is included as an appendix.

In addition to administering the questionnaire, qualitative interviews were held with a small number of respondents shortly after each round of questionnaire administration. The aim of the interviews was to probe into the reasoning behind student self-efficacy perceptions. The questions asked concerned the reasons for the self-efficacy scores that respondents had given themselves. Interviewees were selected to represent those rating themselves, low, moderate and high in terms of self-efficacy. The interviewee probed for prior educational experiences, and how these had affected the respondent's self-perception as good or bad at numeric and financial analysis.

Preliminary Results

This paper has been prepared after the first round of questionnaire administration and student interviews. By the date of the Academy of Marketing conference both phases of data collection will have been completed and analysed, so that complete results can be presented to delegates. Here we present brief findings from the first round of data collection. In this first round the questionnaire was administered to 127 final-year undergraduate students, with a mean age of 21.85 years, split 56.7% female, 43.3% male.

Table 1: Respondent mean scores on self-efficacy and objective tests (all respondents)

	Respondents	Minimum	Maximum	Mean	Standard deviation
1. Self-efficacy (on 1 to 8 scale)	115	1.00	7.80	4.56	1.59
2. Score/15 on objective test	127	0	10	4.25	2.53
3. Score/10 on numeric calculations (included in row 2)	127	0	10	4.14	2.52
4. Score/5 on financial questions (included in row 2)	127	0	1	0.11	0.31

Table 1 shows that there was an enormous range within the student group in terms of both self-efficacy and objective test results, with all variables spanning almost the entire range of possible values. Bearing in mind that the minimum possible response for mean self-efficacy was 1.00 (not confident at all), and that there were five questionnaire items measuring self-efficacy, this shows that there was at least one respondent who responded (1) to all the self-efficacy questions, and at least one respondent who answered (8) to all but one of the self-efficacy questions and (7) to the other. Similar variation is seen in the responses to the ten numeric calculation questions, with scores from 0 to 10. However, virtually none of the students had any success with the financial questions, even though these were of the type taught on a first year accounting module. There was a high correlation between self-efficacy and scores achieved on the objective test out of 15 (R=0.406, significance level 0.000). This is in line with prior research that has found a high, positive correlation between self-efficacy and performance (Bandura 1977, 1997; Pajares 1996).

Table 2: Respondent scores and entry qualification

	High school in another country (N = 25)	A levels (N = 47)	UK Vocational qualification (N = 34)
1. Self-efficacy (on 1 to 8 scale)	5.28	4.57	4.11
2. Score/15 on objective test	5.12	4.43	3.38
3. Score/10 on numeric calculations (included in row 2)	5.00	4.30	3.32
4. Score/5 on financial questions (included in row 2)	0.12	0.13	0.06

Table 2 shows that there was considerable variation in both self-efficacy and in objective scores between groups of students with different entry qualifications. The table indicates that, of the three student groups for which sufficient responses were available, students who came to university with an overseas qualification had the highest self-efficacy and the highest objective scores, followed by students with A-levels, and then by students with UK vocational entry qualifications. Note, however, that despite the persuasiveness of the data, the only differences that are statistically significant in Table 2 (using an independent samples t-test) are those between students with overseas qualifications and students with UK vocational qualifications.

Initial analysis showed no systematic relationship between respondent age or ethnicity and either self-efficacy scores or scores on the numeric and financial tests. However, there was some evidence that men had higher self-efficacy than women (not statistically significant), and the male respondents did out-perform the female respondents on the numeric section of the test (male mean 4.85/10, female mean 3.60/10, significance level 0.005), but not the financial section.

The first interviews were conducted in the two week(s) following student's completion of the questionnaire. Three female and four male students were asked to comment on how they felt about their performance in the analytical skills test, how they remembered scoring themselves on the self-efficacy questions, their self-perceptions about their numerical abilities, and their experiences with maths education prior to coming to University.

Only two of the interviewees, one male and one female, remembered scoring themselves highly on the self-efficacy questions and yet neither of these students did particularly well on the test itself. The female student had a mixed self-perception of her numeric abilities, stating that she was good at maths largely because her previous education in Austria was heavily focussed on maths and her parents had hired a tutor so that she could improve her scores. She felt that the extra tuition was

largely responsible for her good scores and greater confidence with numbers but that she did not see herself as a "numbers person" as this required "logical thinking", something she felt she was not particularly good at.

The remaining interviewees had similar self-perceptions about their maths ability – all felt they were either not very good or very poor with numbers, calculations and maths. Of this group, one student remembered giving herself the lowest possible score on all of the self-efficacy questions on the survey and described herself as "terrible" at numbers, not remembering a time that she was good at them, and feeling that this was not only a personal weakness but one that may hold her back in her career. She was the only student who remembered one of her parents comparing her maths scores negatively against a sister who was particularly good at maths.

In all other cases, the students remembered a time in (primary) school when they were "good" at maths and numbers but that as they moved on in school they began to feel less confident and remembered doing poorly in maths classes and on maths tests. Various reasons were given for this. Some students stated that it was their experiences in the classroom that made the difference: "the tutors were not willing to help you as much" or "the tutors made you come to them if you wanted help whereas in primary school they would help you" or "those who were good at maths weren't willing to help you". Others placed the locus of blame on themselves, stating that it was at about the age of 14 that they really understood that they were not good at numbers. When asked whether their feelings about their maths abilities affected their choice of degree, five out of the seven students interviewed said that it had. They either chose a degree that they perceived was not heavily numbers focussed or they chose a degree based on their perceived strengths in areas other than maths. In all of these cases, marketing-related subjects were perceived as not being heavily maths oriented. Nevertheless, six out of the seven students interviewed felt that maths would be important in their careers, that maths is "part of everyday life", and that you "need to understand numbers" to be successful, and most said they would be willing to get the help they needed in the future if they were confronted with numbers in their jobs.

At this stage in the module, the students were just beginning to feel confident about their ability to understand the simulation and how to make decisions and most felt that the simulation was useful in reminding them about the importance of numerical analysis in "the real world" and in business. One student at this stage stated that simulations were a good way to learn financial calculations because you were learning it in the context of a "real" business situation rather than "just being given formulas to do that were not related to anything".

Conclusion

The initial findings suggest that the final year students on this strategic marketing module had fairly poor skills in the quantitative analysis of marketing data and in financial analysis. Objective performance was positively correlated with self-efficacy in numerical and financial tasks. There was some evidence that performance in such tasks is associated with prior qualifications; students who matriculated from overseas high schools seemed to out-perform those with UK qualifications. A suggestion emerged from the qualitative interviews that some marketing students may have selected their degree because they believed that it would not involve quantitative reasoning.

Once the project is complete it will be possible to analyse students' self-efficacy and objective scores before and after participation in the simulation game. These results will be presented to delegates at the conference.

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APPENDIX

Marketing Student Quantitative Skills Questionnaire

We hope that your experience on our module will help you to understand how marketing and financial data are used to make business decisions. This is the first of two questionnaires we will be administering during the module. We have two reasons for doing this. First, we want to get an idea of how comfortable you are with the sorts of analyses we will be doing in the module; and second, we want to use this opportunity to check your answers and give you feedback. That's why we ask for your student number—but don't worry; the only people who will see your questionnaire are you and ourselves as module tutors.

Please write in your student number

M								

1 Your gender (please tick one)

Male		1
Female		2

2 Your age (please write in)

	Years

3 Your ethnic background (Please tick one)

White		1	Black or Black British		4
Mixed		2	Chinese		5
Asian or Asian British		3	Other		6

4 Which type of qualification did you use to get a place on your MUBS programme? (Please tick one only)

A levels		1
Vocational qualification [e.g. BTEC]		2
Access course		3
High school in another country		4
Other		5

Please look at Table 1. This shows the sales report for a product called the CPC100 photocopier. Suppose you were asked to do the following calculations or tasks. Please indicate how confident you are that you would be able to do each correctly.

The confidence scale runs from (1) meaning "not confident at all" to (8) meaning "completely confident". Tick the number that matches your own feeling of confidence for the task.

5 Calculate the share of marketing expenditure that was spent on market research in April

Not confident at all (1)	(2)	(3)	(4)	(5)	(6)	(7)	Completely confident (8)

6 Prepare a revised forecast for sales volume for the period July to December, taking account of the actual data for January to June

Not confident at all (1)	(2)	(3)	(4)	(5)	(6)	(7)	Completely confident (8)

7 Calculate the variance (in £ and in %) between forecast and actual advertising spend in July, if the actual spend was £27,650

Not confident at all (1)	(2)	(3)	(4)	(5)	(6)	(7)	Completely confident (8)

8 Prepare, from a blank spreadsheet, a similar spreadsheet to Table 1, showing all the same components shown in Table 1, but for a different product.

Not confident at all (1)	(2)	(3)	(4)	(5)	(6)	(7)	Completely confident (8)

9 Calculate the sales revenue generated per £1 of advertising expenditure for each month and for the year-to-date

Not confident at all (1)	(2)	(3)	(4)	(5)	(6)	(7)	Completely confident (8)

Please answer Questions 10-19, using the information in the next two paragraphs.
You recently joined a company that markets portable DVD players, as a Graduate Marketing Trainee. Today you attended a meeting where the Sales Director discussed the most recent sales figures. Read what the Sales Director said, and then answer the questions below:

"Our sales forecast for last month was £235,000, but actual sales exceeded that figure by £26,000. Our recommended retail price is £90 per unit, but we have noticed quite a lot of price discounting. For example, the online retailer *TVs Direct* is selling our DVD player at a 20% discount on the recommended price. At the recommended price of £90 the retailer makes a gross profit margin of £30. Our market research company has suggested that we should increase the recommended retail price to £100, but I'm worried that would make us uncompetitive."

	Question	Your answer	For office use	
10	At what price is *TVs Direct* selling the DVD player?		1	2
11	What percentage increase in recommended retail price is the market research company suggesting?		1	2
12	What gross profit margin (in pounds) is *TVs Direct* making on each DVD player?		1	2
13	What actual sales did your company achieve last month?		1	2
14	What percentage gross profit margin does a retailer make if they sell your DVD player at the recommended retail price of £90?		1	2

At the interview for the job of Graduate Management Trainee you were asked to sit a short test. Answer the following questions from the test.

	Question	Your answer	For office use	
15	In 2010 our sales revenue was £2.4 million. This year we are forecasting sales to be 12% higher – calculate a forecast for this year's sales.		1	2
16	In 2010 our share of the total UK market was 17%. Provide an estimate of the overall size of the UK market (you do not need to calculate this exactly, we are looking for a good approximation).		1	2
17	Our gross profit per unit is £20. The overhead costs of running the business are £400,000. At what sales volume do we start to generate a net profit? (To say the same thing in different words: What is our break-even sales volume?)		1	2

18	In 2010 our sales revenue was £2.4 million, our variable costs were £1.0 million, and our overhead costs were £400,000. Calculate our total net profit for 2010.		1	2
19	What fraction of £2.4 million is £400,000?		1	2

Please answer the following questions based on Table 2.

	Question	For office use	
20	Briefly explain how you would calculate the gross profit percentage for Charles Smith Menswear	1	2
	Your answer		
21	Briefly explain how you would calculate the average inventory (at cost) held by Charles Smith Menswear	1	2
	Your answer		
22	Given that Charles Smith Menswear has a total investment of £150,000 explain how you would calculate the company's return on investment (ROI)?	1	2
	Your answer		
23	Suppose that 'purchase discounts' were £28,000 rather than £15,000; what would the figure for 'gross margin' be?	1	2
	Your answer		
24	What net profit percentage did Charles Smith Menswear achieve?	1	2
	Your answer		